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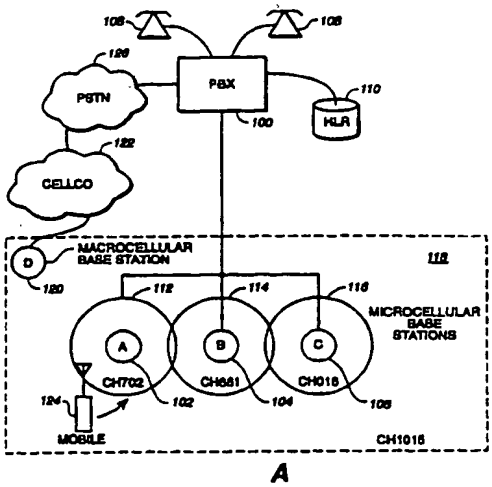
(57) Abstract

A method and apparatus for switching between a public macrocellular telephone system and a private microcellular telephone system is described. A mobile telephone switches between a macrocell and at least one neighbor microcell. Circuitry in the telephone monitors the signal quality of signals from the macrocell (118) and the neighbor microcells (112, 115, 116). Reselection circuitry reselects the telephone from a current microcell to the neighbor macrocell based upon a preferred neighbor status of the microcell. The reselection is based, at least in part, upon the signal quality associated with the macrocell exceeding the signal quality associated with the current microcell by a nonzero offset. The reselection may also be based, at least in part, upon the signal quality associated with the current microcell falling below a predetermined threshold. Further reselection may additionally be based upon the signal quality associated with the macrocell exceeding the predetermined threshold. Reselection from a current macrocell to a neighbor microcell may be based, at least in part, upon the signal quality associated with the neighbor microcell and a predetermined threshold. In that case, reselection may be based upon the microcell signal quality exceeding the predetermined threshold. For reselection from a current microcell to a neighbor microcell, the reselection may be based upon a regular neighbor status of the current microcell. Such reselection may occur if the signal quality associated with the neighbor microcell exceeds the signal quality associated with the current microcell by a nonzero offset.



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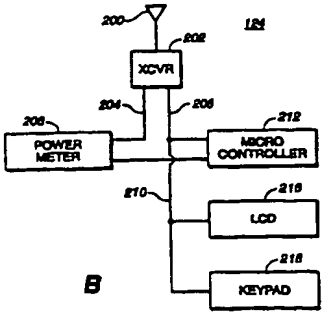

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METHOD AND APPARATUS FOR SWITCHING BETWEEN PUBLIC MACROCELLULAR TELEPHONE SYSTEM AND PRIVATE MICROCELLULAR TELEPHONE SYSTEM

BACKGROUND

Field of the Invention

The present invention relates to the field of cellular telephony, and in particular to private cellular telephone systems.

Description of the Related Art

A cellular telephone network includes a number of radio cells that are served by fixed base station transceivers. Most cellular customers subscribe to a public cellular service provider, known as a "cellco." When a mobile subscriber unit powers up within the coverage area of a cell that is served by the cellco, the mobile registers with the cellco through the corresponding cell.

The number of subscribers to cellcos in the United States and abroad has increased dramatically in the past decade. In more recent years, communications companies have recognized the need to tailor public network functions to the requirements of individual businesses. For example, Internet companies have begun to exploit the market for corporate-based Intranet solutions. Similarly, cellular networking companies have developed microcellular networks in which a private network is set up at a business site. The base stations serving the microcells are typically located in corporate offices and coupled to the PBX of the business. When the mobile subscriber roams into the business site, the phone registers with the private network and can thus act as a desk phone that is served by the PBX. When the mobile is registered with the private network, it is no longer under the jurisdiction of the public cellco, and therefore is not charged cellco telephone rates.

Private cellular networks have been developed by Northern Telecom Limited, the assignee of the present invention. See, for example, U.S. Patent No. 4,771,448, issued to Koohgoli, et al., and U.S. Patent No. 5,537,610, issued to Mauger, et al., both patents assigned to Northern Telecom. Also refer to U.S. Patent No. 5,235,632, issued to Raith. These and all other references herein are incorporated by reference herein.

When a mobile subscriber roams from a public system to a private system, it must register with the private system. One standard roaming technique requires that the mobile monitor the signal strengths of control channels corresponding to the public macrocells and the private microcells. When the signal strength of a microcell exceeds a predetermined threshold, then the mobile logs in with the private network. The mobile continues to monitor the control channels, and when the signal strength of the private network falls below the threshold, then the mobile logs in with the public network.

As the subscriber moves within the business site, the measured signal strength will vary. Therefore, care must be taken to select the proper threshold so that the internal control channel does not appear to drop out. Dropout will cause the subscriber to register with the external system, even though the user may still be within the confines of the corporate building site. Accordingly, it is desired to find a way to maintain registration with the private network that is not overly sensitive to variations in signal quality as the subscriber roams within the corporate site.

SUMMARY OF THE INVENTION

The present invention provides a method and apparatus for switching between a public macrocellular telephone system and a private microcellular telephone system. According to the invention, a mobile telephone switches between a macrocell and at least one neighbor microcell. Circuitry in the telephone monitors the signal quality of signals from the macrocell and the neighbor microcells. Reselection circuitry reselects the telephone from a current microcell to the neighbor macrocell based upon a preferred neighbor status of the microcell. The reselection is based, at least in part, upon the signal quality associated with the macrocell exceeding the signal quality associated with the current microcell by a nonzero offset. The reselection may also be based, at least in part, upon the signal quality associated with the current microcell falling below a predetermined threshold. Further, reselection may additionally be based upon the signal quality associated with the macrocell exceeding the predetermined threshold.

Reselection from a current macrocell to a neighbor microcell may be based, at least in part, upon the signal quality associated with the neighbor microcell and the predetermined threshold. In that case, reselection may be based upon the microcell signal quality exceeding the predetermined threshold.

For reselection from a current microcell to a neighbor microcell, the reselection may be based upon a regular neighbor status of the current microcell. Such reselection may occur if the signal quality associated with the neighbor microcell exceeds the signal quality associated with the current microcell by the nonzero offset.

The telephone can also include a neighbor list that lists frequencies associated with the macrocell site and the microcell sites. These frequencies are monitored by the metering circuitry. The microcells in the neighbor list are

sequentially listed in order of decreasing preference, so that the first target microcell having a satisfactory signal quality is chosen for reselection.

The macrocell is associated with a first network, which may be a public network, and the microcells are associated with a second network, which may be a private network. The two networks operate on different control channels to avoid interference. The telephone is accessed by a first directory number when registered with the macrocell site, and accessed by a second directory number when registered with a microcell site. A home location register associated with the second network associates the second directory number with the first directory number when the telephone is registered with a microcell site.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a simplified block diagram illustrating a cellular telephone system according to the present invention.

Figure 1B is a simplified block diagram illustrating a standard mobile telephone unit, which can be reprogrammed according to the present invention.

Figure 2 illustrates a neighbor list according to the present invention.

Figure 3 is a simplified flow chart diagramming the operation of the present invention.

Figure 4 is a chart illustrating the reselection algorithm of the present invention.

Figure 5 illustrates a home location register according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a method and apparatus for switching between a public macrocellular telephone system and a private microcellular telephone system. In the following description, numerous details are set forth in order to enable a thorough understanding of the present invention. However, it will be understood by those of ordinary skill in the art that these specific details are not required in order to practice the invention. Further, well-known elements, devices, process steps and the like are not set forth in detail in order to avoid obscuring the present invention. Finally, please note that the term "circuitry" as used herein refers to any hardware, software and/or firmware for performing the functions described herein.

Figure 1A is a simplified block diagram illustrating a cellular telephone system according to the present invention. The private, microcellular telephone system of the present invention operates in conjunction with a public, macrocellular system. The illustrated microcellular system includes a PBX 100 that controls switching of private base stations A 102, B 104 and C 106. The PBX 100 may, for example, be implemented with a MERIDIAN M1 (Northern Telecom trademark) private branch exchange. The figure also illustrates desk phones 108 connected by wire to the PBX, and a home location register (HLR) 110 serving the PBX. The HLR 110 is a database that contains subscription information, service activation information and current location information for each subscriber within the private network. The HLR 110 also contains subscriber verification information. Further information concerning HLRs may be found in U.S. Patent No. 5,537,594, issued to Maidenhead et al., and assigned to Northern Telecom, incorporated by reference herein.

The radio coverage areas of the private base stations define the microcells of the private network. In this example, it is assumed that three microcells 112, 114, 116 serve a corporate site. Each cell is associated with a control channel, and

at least one voice/data traffic channel. Here, base station A operates on control channel 702, B operates on control channel 681, and C operates on control channel 016. The microcells of the corporate site fall within a macrocell 118 served by a macrocellular base station D 120, which is coupled to the cellco 122 and operates on control channel 1015. These control channels are defined by the IS-136 standard, as is well known in the art. The figure shows a mobile subscriber unit 124 within the macrocell 118 being served by base station D 120 and approaching the microcell 112 served by base station A 102.

Figure 1B is a simplified block diagram illustrating a standard mobile unit 124, such as a Nokia Model No. 2160, which has been reprogrammed according to the present invention. The phone 124 includes an antenna 200 coupled to a transceiver 202. The transceiver 202 includes an RF interface and analog-to-digital and digital-to-analog circuitry. The transceiver 202 has an analog output 204 coupled to a power meter 206, and a digital input/output 208 coupled to a system bus 210, which carries address/data and control signals. The bus is coupled to a microcontroller 212 for controlling the operation of the telephone. The unit also incorporates an LCD output 216 and a keypad input 218 coupled to the bus 210.

The CPU 212 controls the frequencies to which the transceiver 202 tunes. Using standard techniques to perform a power measurement, the CPU 212 tunes the transceiver 202 to a selected control channel, and instructs the power meter 206 to measure the received power. The CPU can also measure bit error rate using known techniques. Power and bit error rate are signal quality indicators typically used for handoff and roaming purposes.

The cellco 122 may be coupled to the PBX 100 of the private network through a public switched telephone network (PSTN) 126. According to the invention, control and traffic channels are allocated between the public and private networks according to an agreement between the private network operator and the

cellco. Within the region of the business site, the public and private frequencies are selected so that they do not overlap. In this manner, the problem of interference between adjacent cells is eliminated.

The mobile unit is said to be registered with a cellular network when its voice/data traffic is linked to other telephones through that network. In a typical digital cellular telephone, the phone measures the signal quality of transmissions from nearby base stations. Based upon these measurements, the mobile unit may register with another cellular system through a base station outside its home system in order to establish a better communications link. When this happens, the mobile is said to be "roaming." For purposes of describing the present invention, the process of changing registration between public macrocells and private microcells will be described as "reselection."

In order to perform reselection, the mobile unit of the present invention must measure the signal quality of neighboring cells. Upon subscription to the private cellular service, the mobile unit is programmed with a neighbor list of cells in the neighborhood of the private, corporate site. The neighbor list, illustrated in **Figure 2**, stores information about the surrounding macrocell and the private microcell system. This information includes the channel numbers corresponding to the control frequencies of the surrounding macrocell and the private operating frequencies of the neighboring microcell control channels. The digital verification color codes (DVCCs) (not shown) corresponding to each channel are also stored in the neighbor list. The DVCCs are codes assigned to each channel to aid spatial reuse, as is well known in the art.

Using standard cellular techniques, upon power-up the phone determines the current cell in which it resides. The phone continually monitors the signal quality of the control channels of neighboring cells to determine whether reselection is required. The reselection algorithm of the present invention is a modification of the roaming algorithm found in many popular cell phones,

including the Nokia Model No. 2160. There are four situations in which roaming or reselection may occur: macrocell to macrocell; macrocell to microcell; microcell to macrocell; and microcell to microcell. The reselection algorithm operates differently depending upon the current cell type c and the candidate cell type *i*.

Assume that the current macrocell is operating on a control channel that is not in the vicinity of the private network. The phone will monitor the signal quality of neighboring macrocells to determine whether reselection is required. The decision is based upon the signal quality measured over the corresponding control channels, including parameters such as signal strength and bit error rates. This process is governed by the standard macrocell algorithm programmed into the phone by the cellco.

Now assume that the current macrocell is operating on control channel 1015. This cell is in the neighborhood of the private network, i.e., wholly or partially covers the area of the business site. This status is indicated in **Figure 2**, with a current cell pointer c pointing to macrocell 1015. The conventional algorithm continues to run to determine whether reselection to a neighboring macrocell is warranted. Note that a neighboring macrocell may share coverage of the business site, especially if the site is sufficiently large.

When the current macrocell covers the private network, as in this example, the phone runs a "private" reselection algorithm of the invention along with the standard macrocell reselection algorithm. The private algorithm uses parameters preferably different from those employed by the public algorithm. In this manner, the private algorithm is autonomous with respect to the public algorithm.

The private reselection algorithm programmed into the phone scans down the neighbor list one-by-one to determine whether reselection to a target candidate

microcell is required. According to **Figure 2**, a target cell pointer i first points to neighboring microchannel 702.

Referring to **Figures 3** and **4**, the algorithm determines whether reselection is necessary based upon a function (step 300) of the measured signal strength of the target microcell and a threshold. The signal strength measured over the control channel of the target cell is compared to a threshold SS_SUFF (sufficient signal strength). The threshold is preferably set to the microcell downlink threshold that is reached just upon entering the building. Downlink refers to the RF link from the base station to the mobile phone. The microcell system should be designed with a downlink threshold equal to -85 dBm or 17 dB above the noise floor, whichever is the worse case. If the microcell signal strength as measured by the phone exceeds this threshold for a time period greater than DELAY (e.g., 0.64 second) (step 400), then the phone reselects to the target microcell 702 (steps 302, 304) and resets the current cell pointer in the neighbor list to the 702 microcell (step 306). The algorithm also advances the target cell pointer to the next target cell on the neighbor list (681 in this example) (step 308). Note that the algorithm does not select the strongest of the three microcells. Rather, it selects the first microcell down the list that has a satisfactory signal quality.

Anytime the phone reselects to a microcell, the private reselection algorithm overrides the public algorithm to prevent reselection to a macrocell according to the parameters set by the cellco. Instead, when the current cell is a microcell, reselection to a macrocell occurs according to the private reselection algorithm, as described below.

To perform the reselection step in **Figure 3**, the mobile monitors transmissions from the PBX to determine whether the mobile is authorized to communicate with the PBX's network. The PBX transmits a private system identification number (PSID). The PSID represents the verification number corresponding to the private system, e.g., a company i.d. The mobile stores the

PSID(s) of the private system(s) for which it is authorized. If the transmitted PSID matches a stored PSID, then the mobile sends a registration request message to the microcell PBX on the corresponding control channel. The message includes the phone's mobile identification number (MIN) and electronic serial number (ESN). The ESN is programmed into the phone upon manufacture. The MIN is programmed into the phone upon subscription to the public cellco service.

Upon receiving the request, the PBX verifies that the phone has authority to register with the private system by comparing the request information with corresponding parameters in the HLR, illustrated in **Figure 5**. If the MIN and ESN match in the HLR, then the PBX registers the phone with the private system and sends a registration acknowledge signal back to the phone.

The HLR also correlates the phone information with a private telephone direct dial phone number, the identification number of the cell control channel, and a user profile for the PBX. The private number comprises a home site ID of the PBX and a four-digit directory number (DN). The private number is the number by which callers outside the private network can dial a desk phone in the private network. The DN, for example, is a four-digit extension by which other private subscribers can reach phones within the network. The private number is associated with the MIN of the cell phone through the HLR.

All incoming calls (whether from within or without the private network) that are directed to the desk phone at the office private number are also directed to the corresponding cell phone through the use of the control channel identified by the cell ID and a traffic channel selected by the PBX. In the case of incoming calls, the PBX pages the cellular phone's MIN over the control channel. The phone acknowledges the page over the control channel, and switches to a traffic channel specified by the page request. The PBX then rings the phone.

Similarly, all outgoing calls placed by the cell phone are treated as if they originated at the corresponding desk phone. The user profile represents the feature set available to the desk phone (and now the cell phone), including calling features such as access to long distance, call forwarding, caller ID, etc. By using the call forwarding feature, a user can be reachable in both the public and the private systems through the private number of the desk phone. First, the PBX recognizes whether the cell phone (identified by its MIN) is registered with the PBX in its HLR. If so, then all calls to the private desk number will reach the cell phone as well. If the cell phone is not registered with the private network, however, then the PBX can activate call forwarding so that all calls placed to the private number are forwarded to the cell phone's MIN over the PSTN.

Going back to the example in which the current cell pointer points to the macrocell 1015, if the SS_SUFF threshold is not exceeded by control channel 702 (step 400), then reselection does not occur (step 302) and the phone advances the target cell pointer to the next cell in the neighbor list (step 308), which in this case is microcell 681. The reselection algorithm is then repeated. If the target cell pointer reaches the end of the neighbor list and no reselection occurs, then the target cell pointer wraps around the list to point to the first available target cell (e.g., 702), and the algorithm of **Figures 3** and **4** is repeated. Note that even if more than one macrocell covers the private microcell area, all macrocells covering that area would share the same neighbor list of microcells. If the current cell is a macrocell, as in this example, then the target cell pointer may only point to a microcell because reselection from one macrocell to another macrocell is only handled by the standard public macrocell algorithm. Of course, the present invention may easily be modified to incorporate macrocell-to-macrocell reselection.

When the mobile moves around within a multi-cell microcell system, it needs to reselect among microcells. Assuming that the current cell is microcell

702, then the target cell pointer will first point to microcell 681, as described above. Internal microcell neighbors are treated as regular reselection candidates, rather than preferred neighbors (discussed below). The phone examines whether the target microcell is stronger than the current cell by a reselection offset RESEL_OFFSET for a time period greater than DELAY (step 402). The reselection offset RESEL_OFFSET can be set, for example, to a value of 6 dB. If this condition is satisfied, reselection to the target microcell 681 occurs.

If the reselection condition is not satisfied for cell 681, then the target cell pointer is advanced to microcell 016 (steps 302, 308). If again the condition is not satisfied, then the target cell pointer wraps around the neighbor list to point to the next available target cell, which is macrocell 702. In contrast to current macrocells, a macrocell can be the target cell of a current microcell so that reselection to a macrocell can occur according to the algorithm of the present invention.

Where, as here, the current cell is a microcell and the target cell is a macrocell, reselection occurs if three conditions are satisfied for a time period greater than DELAY: the signal strength of the current microcell falls below the microcell SS_SUFF threshold; the signal strength of the target macrocell exceeds the signal strength of the current microcell by a value RESEL_OFFSET; and the signal strength of the target macrocell exceeds the threshold SS_SUFF (step 404). These conditions demonstrate the asymmetric relationship between macrocells and microcells. Microcells hold a preferred neighbor status with respect to macrocells. That is, a higher signal quality is required of a macrocell to reselect the macrocell when the phone is already registered with a microcell. Conversely, reselection from a macrocell to a microcell requires a lower microcell signal quality. Upon reselection to a macrocell, the private reselection algorithm again allows the public macrocell algorithm to run simultaneously to permit reselection to another macrocell, if necessary.

As the mobile subscriber moves away from the microcell coverage area, the signal strength measured from the current microcell may fall below the threshold, but the macrocell signal strength may not satisfy the latter two conditions. This may occur if there is poor macrocell coverage outside the private network. Therefore, the target macrocell signal strength is also compared to a value RSS_ACC_MIN (reselection signal strength access minimum) (step 406). An exemplary value of RSS_ACC_MIN is -90dB. If the measured signal strength falls below this value, then the mobile unit is deregistered from the private network. The mobile may display an indication that service is unavailable in that case.

Although the invention has been described in conjunction with particular embodiments, it will be appreciated that various modifications and alterations may be made by those skilled in the art without departing from the spirit and scope of the invention. The invention is not to be limited by the foregoing illustrative details, but rather is to be defined by the amended claims.

CLAIMS

What is claimed is:

1. A mobile telephone for switching between a macrocell and at least one neighbor microcell, comprising:

metering circuitry for monitoring the signal quality of signals from the macrocell and the at least one neighbor microcell; and

reselection circuitry for reselecting the telephone from a current microcell to the neighbor macrocell based upon a preferred neighbor status of the microcell.

2. The telephone of claim 1, the reselection being based, at least in part, upon the signal quality associated with the macrocell exceeding the signal quality associated with the current microcell by a nonzero offset.

3. The telephone of claim 2, the reselection being based, at least in part, upon the signal quality associated with the current microcell falling below a predetermined threshold.

4. The telephone of claim 3, the reselection being based, at least in part, upon the signal quality associated with the macrocell exceeding the predetermined threshold.

5. The telephone of claim 1, the reselection circuitry for further reselecting the telephone from a current macrocell to a neighbor microcell based, at least in part, upon the signal quality associated with the neighbor microcell and a predetermined threshold.

6. The telephone of claim 5, the reselection circuitry for reselecting from a current macrocell to a neighbor microcell based, at least in part, upon the signal

quality associated with the neighbor microcell exceeding the predetermined threshold.

7. The telephone of claim 6, the reselection from a current microcell to a neighbor macrocell being based, at least in part, upon the signal quality associated with the current microcell falling below the predetermined threshold.

8. The telephone of claim 7, the reselection from a current microcell to a neighbor macrocell being based, at least in part, upon the signal quality associated with the macrocell exceeding the predetermined threshold.

9. The telephone of claim 1, the reselection circuitry for further reselecting from a current microcell to a neighbor microcell based upon a regular neighbor status of the current microcell.

10. The telephone of claim 9, the reselection circuitry reselecting from the current microcell to the neighbor microcell if the signal quality associated with the neighbor microcell exceeds the signal quality associated with the current microcell by a nonzero offset.

11. The telephone of claim 5, further comprising a neighbor list, the neighbor list listing frequencies associated with the macrocell site and the at least one neighbor microcell, wherein the frequencies are monitored by the metering circuitry.

12. The telephone of claim 11, the microcells in the neighbor list being sequentially listed in order of decreasing preference, wherein the first microcell in the list having a satisfactory signal quality is chosen for reselection.

13. The telephone of claim 1, the macrocell being associated with a first network and the at least one microcell being associated with a second network, wherein the second network operates on different control channels than the first network.

14. The telephone of claim 13, wherein the first network is a public network and the second network is a private network.

15. The telephone of claim 13, wherein the telephone is accessed by a mobile identification number when registered with the macrocell site, and accessed by a directory number when registered with a microcell site.

16. The telephone of claim 15, wherein a home location register associated with the second network associates the directory number with the mobile identification number when the telephone is registered with a microcell site.

17. The telephone of claim 1, wherein at least one microcell associated with the at least one microcell site lies within a macrocell associated with the macrocell site.

18. A method for switching a mobile subscriber between a macrocell and at least one neighbor microcell comprising the steps of:

monitoring the signal quality of signals from the macrocell and the at least one neighbor microcell; and

reselecting the subscriber from a current microcell to a neighbor macrocell based upon a preferred neighbor status of the microcell.

19. The method of claim 18, the reselection being based, at least in part, upon the signal quality associated with the macrocell site exceeding the signal quality associated with the current microcell by a nonzero offset.

20. The method of claim 19, the reselection being based, at least in part, upon the signal quality associated with the current microcell falling below a predetermined threshold.

21. The method of claim 20, the reselection being based, at least in part, upon the signal quality associated with the macrocell exceeding the predetermined threshold.

22. The method of claim 18, further comprising the step of reselecting the subscriber from a current macrocell to a neighbor microcell based, at least in part, upon the signal quality associated with the neighbor microcell and a predetermined threshold.

23. The method of claim 22, the step of reselecting from a current macrocell to a neighbor microcell based, at least in part, upon the signal quality associated with the neighbor microcell exceeding the predetermined threshold.

24. The method of claim 18, further comprising the step of reselecting from a current microcell to a neighbor microcell based upon a regular neighbor status of the current microcell.

25. The method of claim 24, the step of reselecting from the current microcell to the neighbor microcell comprising the step of reselecting from the current microcell to the neighbor microcell if the signal quality associated with the neighbor microcell exceeds the signal quality associated with the current microcell by a nonzero offset.

26. The method of claim 22, further comprising the step of reselecting to the first microcell in a neighbor list that has a satisfactory signal quality.

27. The method of claim 18, wherein the subscriber is accessed by a mobile identification number when registered with the macrocell site, and accessed by a directory number when registered with a microcell site.

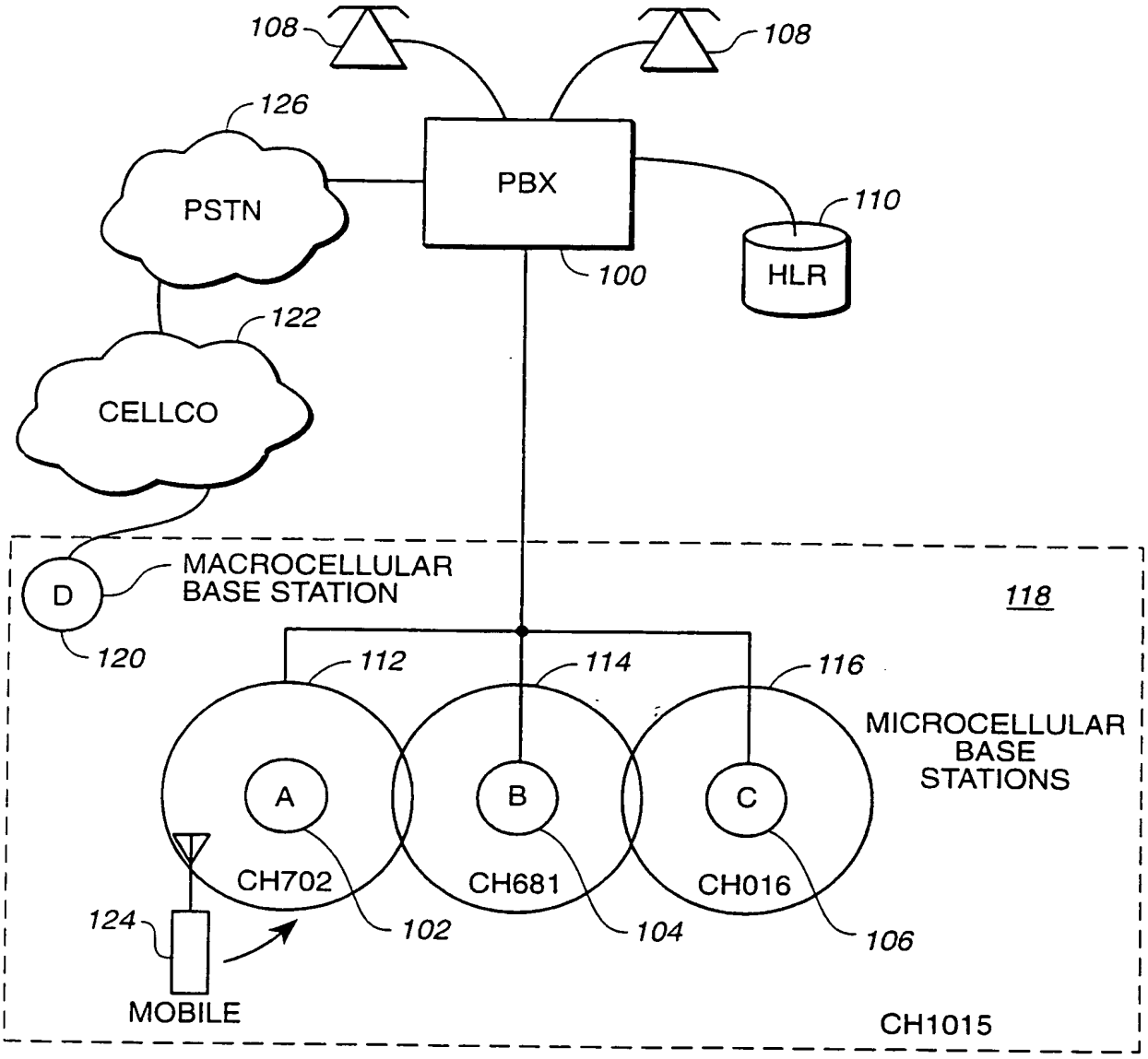

FIG._1A

FIG._2

NEIGHBOR LIST

CURRENT CELL POINTER c → 1015 MACROCELL

TARGET CELL POINTER i → 702, 681, 016 MICROCELLS

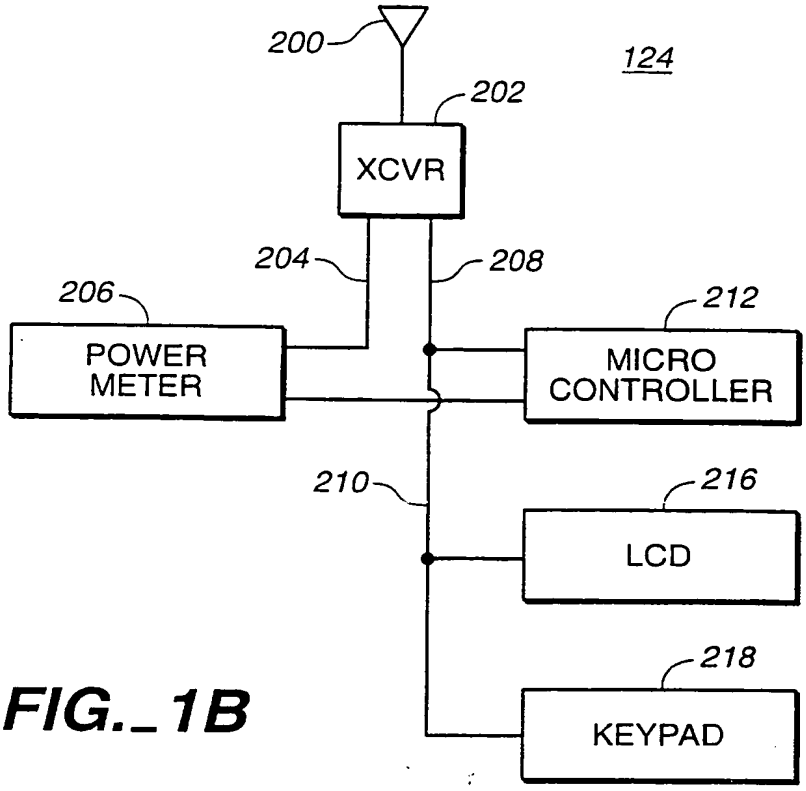

FIG._1B

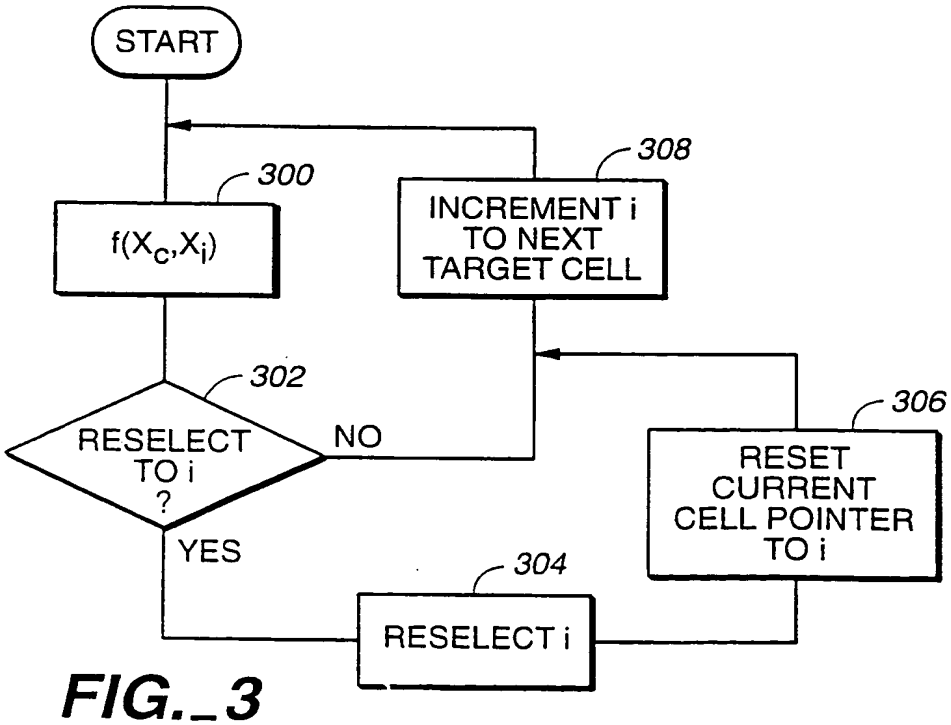

FIG._3

$f(X_c,X_i)$ 300

400	c = MACRO i = MICRO	X_i > ss _ suff for t > DELAY	
404	c = MICRO i = MACRO	X_c< ss_ suff AND $X_i > X_c$ + RESEL_OFFSET AND X_i > ss _ suff FOR t > DELAY	X_c < ss_ suff AND X_i < RSS_ACC_MIN THEN DEREGISTER FROM MICROCELL
402	c = MICRO i = MICRO	$X_i > X_c$ +RESEL_OFFSET FOR t > DELAY	

406

c = CURRENT CELL
i = TARGET CELL
X_c = CURRENT CELL SIGNAL STRENGTH
X_i = TARGET CELL SIGNAL STRENGTH

FIG._4

PRIVATE NUMBER HLR

MIN	ESN	HOME ID	DN	CELL ID	USER PROFILE
415-555-1234	12345	555	6542	702	–

FIG._5

INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/IB 98/01216

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 5 574 775 A (R.R.MILLER & AL.) 12 November 1996 see claim 1 see column 16, line 25 - line 31 ---	1,18
X	EP 0 526 436 A (TELEFONAKTIEBOLAGET L M ERICSSON) 3 February 1993 see the whole document ---	1-10, 18-25
P,X	WO 98 19474 A (NORTHERN TELECOM LTD ;CHRISTIE EARL (US); HANLEY DONALD (US); MCCA) 7 May 1998 see page 4, line 15 - line 27 ---	1,2,5-7, 9,18,22, 23
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 December 1998	17/12/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Leouffre, M

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INTERNATIONAL SEARCH REPORT

Int .tional Application No
PCT/IB 98/01216

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Inte onal Application No
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